PO-0793

Assessment of kV cone-beam CT dose, for children undergoing image-guided radiotherapy.

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Purpose/Objective: Treatment plans for children undergoing radiation therapy become increasingly complex due to increased use of IMRT/arc therapy.This puts higher demands on patient positioning accuracy. Daily kV cone beam computed tomography (kVCBCT) is an excellent tool for this purpose, but it does also add an additional dose to normal tissue close to the treatment area. The purpose for this study was to determinate a quantitative method for the estimation of kVCBCT doses in pediatric patients undergoing image-guided radiotherapy.
Materials and Methods: The dosimetric concept generally used in CT is basedon measurements of the computed tomography dose index (CTDI). The CTDI is measured with ionization chamber in a standard dosimetry phantom, and the effective dose and organ dose is calculated using a standard tool like the Excel-program CT Expo.There are several challenges in extending this method to CBCT, including definition of CTDI for a cone beam, different beam quality due to filtering, and the fact that CBCT can be limited to a 200° scan angle for head and neck modes. We have therefore measured dose in selected organs in anthropomorphic children phantoms corresponding to the age 1, 5 and 10 years with the romluminescence detectors (TLD). These measurements were compared to doses calculated by astandard CTDI approach/ CT Expo, and the differences assessed.
Results: We found significant differences in the doses given bythe CTDI approach and direct measurements with TLDs. Especially this is true for the dose to lens, where the selected scan range for a 200° scan is the main contributing factor.
Conclusions: The well-known methods from CT such as CTDI can not be directly adapted for kVCBCT images. In the absence of standardized absorbed dose metric comparable with the CTDI used in conventional CT, estimation of an effective dose should be calculated from point dose measurements with TLD detectors in anthropomorphic phantoms. In a clinical setting CBCT at an accelerator typically have only a few predefined settings of kV and mA depending on anatomical region. It is therefore advisable to keep a table over measured organ doses in anthropomorphic phantoms for standard clinical conditions as a reference.

PO-0794

Evaluating the usefulness of EPID for daily output verification by comparison to ionization chamber measurements

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Purpose/Objective: To investigate the long term stability of the amorphous silicon electronic portal imaging device (aSi EPID) for monitoring medical linear accelerator output, by a) acquiring output data on a daily basis using the EPID, b) correlating EPID data to weekly measurements using an ionization chamber in a Perplex phantom and c) correlating as well as calibrating EPID response to absolute measurements with an ionization chamber in water.
Materials and Methods: A test patient, including two open fields (25x25 cm^2, 6 and 15 MV) intended for output measurements with the EPID, was defined. During a period of > 8 months, daily measurements were performed on 9 different medical linear accelerators (8 x Varian Clinac 2300iX and 1 x Varian TrueBeam), equipped with aSi EPIDs (Varian aS1000). Data from the EPID measurements was extracted, using a in-house software developed in MATLAB©, and compared to weekly output measurements with an ionization chamber in a Perplex phantom as well as to quarterly (or on indication) measurements with an ionization chamber in water. Calibration of the EPIDs were performed in conjunction with the ionization chamber measurements in water, also at which point the LINAC output was adjusted to within ±0.3% of the reference data based on the measurements in water.
Results: The ability of the EPID to detect output variation was confirmed by the correlation between the EPID measurements and the ionization chamber measurements in the Perplex phantom as well as in water (Figure 1), for both the Varian Clinac 2300iX as well as for the TrueBeam. However, a variation in performance between some EPIDs is present, possibly in some extent as a result of the differences in the wear and tear of the EPIDs. It is also clear that a daily variation of the EPID data exists and needs to be considered when selecting tolerance levels. Some of the EPIDs detected a greater increase in output over time in comparison to the increase in output detected by the ionization chamber measurements. However, regular calibration of the EPIDs in conjunction with the measurements in water proved to be a solution for this exception.

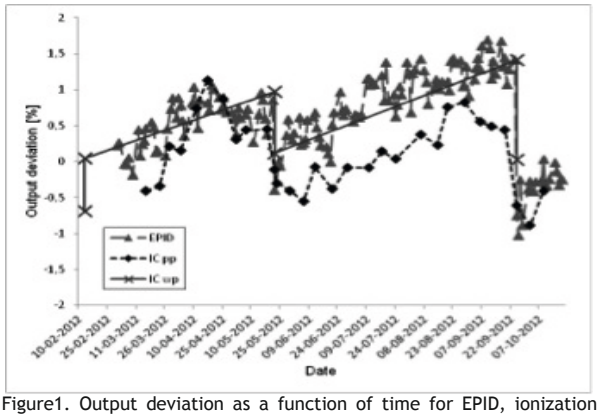

Figure1. Output deviation as a function of time for EPID, ionization chambermeasurements in a Perplex phantom (IC pp) and ionization chamber measurementsin a water phantom (IC wp).

Conclusions: The Varian aSi EPID has been proven to be suitable for fast relative measurements of the LINAC output on a daily basis. However, regular (at least quarterly) calibrations of the EPIDs are essential for a clinic to be able to rely on the EPID as a quality assurance tool for daily verification of the LINAC output.The user independence and the fact that it is a two-dimensional detector mounted directly on the LINAC is some of the important advantages, giving also the possibility to readily verify beam quality, beam profile parameters (e.g. symmetry, flatness and field size) and MLC performance.

POSTER: PHYSICS TRACK: DOSE CALCULATION

PO-0795

Validation and one year experience with an independent redundant calculation software for VMAT fields

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Purpose/Objective: It is accepted that the QA process previous to any treatment must include a redundant independent dose calculation. For conventional radiotherapy these calculations could even be performed manually using dosimetric data. On the other hand, for intensity modulated fields more complex software is required. Diamond ('K&S Associates') is a software with capabilities to calculate VMAT (Volumetric Modulated Arc Therapy) fields. Validation and one year experience for VMAT fields are presented in this work.
Materials and Methods: For VMAT validation, a set of 59 clinically accepted plans was selected including different locations. The treatment planning system (TPS) used was Eclipse v10.0. First, the plans were recalculated on a cylindrical phantom. The recalculated plans were then exported to Diamond, where dose calculation was carried out at the isocenter. In Diamond, non-water equivalent relative electronic density of phantom was accounted for by setting an effective depth determined by the TPS. Results were analyzed obtaining average deviations and standard deviation values from the comparisons Diamond versus measurements and versus TPS. Experimental measurements were performed by using a pin-point chamber. In one year 476 VMAT plans were produced. These plans were grouped by location (abdomen, prostate, pelvis, torax, lung, brain, H&N, radiosurgery and SBRT), recalculated in the TPS without heterogeneity and then, exported to Diamond including body contour. A comparison between Diamond an Eclipse at isocenter was made.
Results:
Validation: An average dose deviation of -0.2 ± 1.7%(1SD) was obtained between Diamond and measurements. Only 2 of 59 values had a deviation above ±3.5% (+5.1 and -4.6%), a linear fit produced a correlation coefficient of 0.9945. Between Diamond and TPS the average deviation found was 0.0 ± 1.6%, correlation coefficient was 0.9951.
One year results: An average deviation of -0.3 ± 1.9% was obtained for the total of plans a linear fit produced a correlation coefficient of 0.9991.Deviations greater than 4% was obtained in 7 plans and maximum deviation of +5.0% was obtained in one plan.
It should be noted that a calculation point different from the isocenter was chosen in one case in the validation process to avoid